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temperature group, are becoming distinct. λ3906 should therefore be placed in Class III, and the fact that Eberhard and others have found it stronger in the arc than in the spark bears out the similarity of behavior to a large number of prominent iron lines, examples being λλ4181.9, 4198.5, 4199.3, 4227.6, 4233.8, 4236.1, 4260.6 and the group of strong lines near λ4900.

The characteristics of λ3906 of silicon, as of these iron lines, are thus first appearance at a temperature above that required for the low-temperature lines, rapid strengthening at higher temperatures and great intensity in the arc. It is therefore a high temperature line of the arc group, not showing the response to high electrical excitation which characterizes the enhanced lines.

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THE SPECTRUM OF *o* CETI NEAR MINIMUM OF LIGHT

Attention was called by us last year to some remarkable changes in the spectrum of *o Ceti* as the star approached its minimum. Recent observations show that these changes have repeated themselves during the corresponding phases of the recent minimum. In addition they show some interesting features not observed previously.

Using the average interval from maximum to minimum of 217 days, the computed minimum fell on February 2. Photographs have been secured as follows with the 100-inch telescope:

NO. OF PLATE	DATE	DAYS FROM MINIMUM
C 760	1920 Nov. 20	−74
766	Nov. 21	−73
801	Nov. 29	−65
847	1921 Jan. 4	−29
859	Jan. 21	−12
861	Jan. 24	− 9
867	Jan. 29	− 4
874	Feb. 15	+13
878	Feb. 17	+15

The 18-inch camera was used for all the exposures except the last three, when the 7-inch camera was used on account of the limited time available.

The outstanding features of the spectrum when compared with that characteristic of the star nearer maximum of light are, in order of time of occurrence: first, the appearance of diffuse components on the red side of the normal bright lines of hydrogen; second, a marked continuous change in the relative intensities of the hydrogen

lines, Hβ becoming far stronger than Hγ and Hδ; third, the appearance of the helium line λ4472 with possible traces of other helium lines; fourth, the weakening or perhaps complete disappearance of the usual sharp bright lines except λ4571; fifth, the appearance and strengthening of a diffuse bright violet component separated from the original stronger red component by an intense absorption line.

1. *The Hydrogen Lines.* The photographs of November 20 and 21 show the sharp and diffuse components for each of the hydrogen lines with a definite absorption line on the violet side of the more refrangible component. The first or sharp component, which is well defined and relatively the stronger of the two on these dates, is identical with the normal bright line seen in the spectrum at maximum, the radial velocity of +50 km. making this fairly certain. The second or diffuse component is not seen at all on photographs taken less than 120 days after maximum in the cases of Hβ and Hγ. In the case of Hδ, however, it seems to take the place of the well-known companion of Hδ which is seen near maximum of light.

A marked change in the relative intensities of the two bright components is seen on the photograph of January 4, the red diffuse component having become much the stronger. There is evidence of another bright line of shorter wave-length on the violet side of the absorption line. The photographs of January 21st and 24th are much underexposed and the bright hydrogen lines visible correspond in position to the diffuse red component.

The photograph C 867 taken on January 29th, only four days before the computed minimum of light is of fair quality, and is well exposed. The dispersion used was necessarily low. Each of the hydrogen lines on this plate consists of two broad bright components of which the red is much the more intense, separated by strong, fairly well-defined absorption lines. The bright components are unsymmetrical, shading away from the absorption line in both cases. The violet component is relatively much stronger than on the plate of January 4th. The absorption line seems narrower and displaced toward the red owing to the encroachment of the bright component on its violet side.

The following brief summary of measures which are corrected for the Earth's motion may aid in following the behavior of these complex lines:

		Hδ	Hγ	Hβ
Nov. 20-21	absorption line.....	4101.05	4339.30	4859.66
	bright sharp comp.....	4102.50	4341.39	4862.44
	bright diffuse comp.....	4103.90	4343.42	4865.05
Jan. 4	bright diffuse comp.....	.....	4337.3	4856.5
	absorption line.....	4101.1	4339.2	4859.4
	bright sharp comp.....	4102.4	4341.3	4862.4
	bright diffuse comp.....	4104.3	4343.2	4864.5
Jan. 21-24	bright diffuse comp.....	.....	4343.0	4864.7
Jan. 29	bright diffuse comp.....	4098.8	4337.3	4857.5
	absorption line.....	4101.7	4340.2	4860.5
	bright sharp comp.....	.....	.....	.....
	bright diffuse comp.....	4104.6	4343.7	4864.5

The apparent increase in wave-length of the bright diffuse component in the case of Hγ and Hδ is probably due to the lack of symmetry of the lines.

The photographs C 874 and C 878 taken some days after the computed time of minimum when the star's brightness had increased very little, if at all, were somewhat underexposed. They show the same features as were found on plate C 867 except that the helium lines λ4472 is weaker.

2. *Helium.* The line λ4472 was seen as a diffuse bright patch on the photographs of November 20th and 21st. It was much stronger on January 4th, and very prominent on January 29th. There are probably traces of λ4026, λ4388, and perhaps λ4922, but this is not certain. The displacement shown by λ4472 is comparatively small, amounting to only 0.4 angstrom in the mean. The line is difficult of measurement on account of its character, but the low value of the displacement is in agreement with that found near the previous minimum.

3. *Bright Lines of Other Elements.* The principal bright lines which can be traced clearly in the spectrum toward minimum of light of the star are λλ4202, 4308 and 4376 of iron, λ4571 of magnesium and the unknown line λ4373. All of these lines, with the possible exception of λ4571, grow fainter as the minimum is approached, and on the photograph taken four days before minimum, altho λ4571 is strong, only a trace of λ4308 is seen and the other lines are invisible.

4. *Absorption Lines.* For the most part the absorption lines on all the photographs are vague and ill-defined. The chromium lines at λ4255 and 4275 are fairly prominent and the characteristic line at λ4739 is well-marked.

5. *The Continuous Spectrum.* This shows comparatively little variation in intensity. The absorption within the titanium oxide bands, however, seems to be less strong near minimum of the star's light than at an earlier phase.

ASYMMETRY IN THE SPECTRUM

A remarkable characteristic of the spectrum near minimum of light is the longitudinal asymmetry of the two components of the hydrogen lines and of the portions of the continuous spectrum adjoining the heads of the titanium oxide bands. The components of the hydrogen lines are displaced with reference to one another along the lengths of the lines giving a peculiar "staggered" appearance, while the ends of the bright regions next to the oxide bands seem to bend away from the normal position of the continuous spectrum.

Measurements on the two components of the hydrogen lines show a longitudinal displacement of about 0.020 mm with reference to one another. This would correspond to slightly more than 0".2 in angular measure at the focus of the telescope and would indicate that the shells of gas producing the two components are displaced by this amount relatively to one another, the second and more diffuse component originating mainly on the following side of the star.

The bending of the continuous spectrum at the edges of the titanium oxide flutings is most prominent at λλ4580, 4740, and 4955. Its explanation will require further investigation.

The position of the helium line λ4472 seems to correspond to that of the second hydrogen component, while the narrow bright lines λλ4202, 4308 and 4571 are probably nearly or quite symmetrical with reference to the continuous spectrum.

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A. H. JOY.

THE PARALLAX OF N. G. C. 226[1]

Fourteen exposures of this object give:

$$\pi \text{rel.} = -0''.011 \pm 0''.003.$$

The nebulosity around the stellar part of this nebula, whose variability was discovered by Hubble, is not quite symmetrical, and extremely good seeing is necessary to secure reliable photographs.

[1] *Astrophysical Journal*, **45**, 351, 1917.